# Environmental Protection Agency

## Horiba Emission Analysis System
## Curve Verification Procedure

This procedure is written for the Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory (NVFEL) internal use. The use of specific brand names by NVFEL in this procedure are for reference only and are not an endorsement of those products. This document may be used for guidance by other laboratories.

### NVFEL Reference Number

012A

### Implementation Approval

Original Procedure Authorized by EPCN #234 on 01-29-99

### Revision Description

(1) 09-18-2001 The purpose of this change is to update the Group Responsible name per EPCN #316

Revision Description

Table of Contents



Figures

Figures Continued

## 1. Purpose

The purpose of this working practice is to describe the equipment and procedure required to perform a curve verification procedure using the Horiba, Mexa-7000, Automotive Emission Analysis System.

## 2. Test Procedure

100 Activate the Horiba Series 7000 Bench according to WP 006, “Horiba Bench Startup.” Additional information is also available in the Horiba “Series 7000 Users Guide.”

**Note:** If you have an internal gas divider, go to Step 103

101 Get the gas divider. Connect the communications cable and all gas lines from the divider to the bench and ensure that the divider is connected to a power outlet.

102 Connect the numbered flexible quick-disconnect jumper lines between the MEXA Analyzer Rack (ANR) Gas Divider Panel and the Solenoid Valve Selector (SVS) of the bench under test. See Figure 1.

| Line Number | Connection |
|---|---|
| 1 | Air |
| 2 | $O_2$ |
| 3 | $N_2$ |
| 4 | To GDC |
| 5 | From GDC |


Figure 1
MEXA Analyzer Rack

103 Ensure that the Gas Divider (GDC) power is turned on. The switch is in the back of the unit.

104 Go to the gas cylinder storage area outside the control room and, for the analyzer under test, note for later use the value of the bottle concentration on the cylinder label.

See the circle in Figure 2.

Figure 2
Cylinder Label

105 From the Gas Lab, get a secondary bottle rack containing a bottle with a concentration close to the value noted in Step 104 and bring the secondary bottle rack to the bottle storage area located outside Room 516.

For later use note the value of the bottle concentration on the cylinder tag.

106 From the secondary bottle rack, select a mid range bottle which should be between 20% - 80% of the range for the curve verification.

For later use note the value of the bottle concentration on the cylinder tag.

107 On the Main Control Unit (MCU), command screen, click on the Horiba logo button in the title bar.

108 From menu items that appear below the button, click on “User Level.”

109 If “Supervisor” is not the top menu item in the display window, click on “Supervisor.”

Use the mouse and on-screen keyboard to click on the letters that spell the password and then click on “Enter”. See Figure 3.

“Supervisor” will appear at the top-center of the screen.

Figure 3
On-Screen Keyboard

110 On the display setup portion of the screen, click on the “Menu” button. From the menu items that appear below the button, click on “Utility.”

111 At the bottom of the screen, click on the “Checks/Tests” button. See the arrow in Figure 4.

From the menu items that appear, click on “Linearize Check” See the circle in Figure 4.

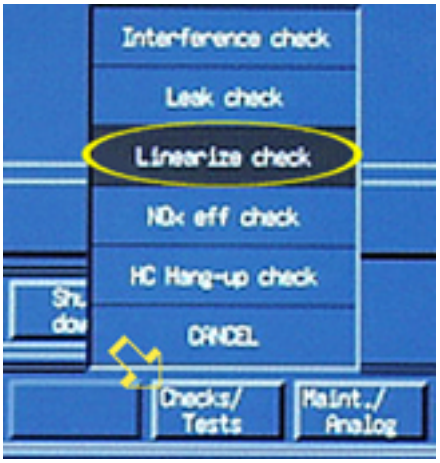


Figure 4
Menu Panel for Linearization Check

112 On the “Analyzer Linearization” panel, click on the “General Parameter Setup” button. See the arrow in Figure 5.

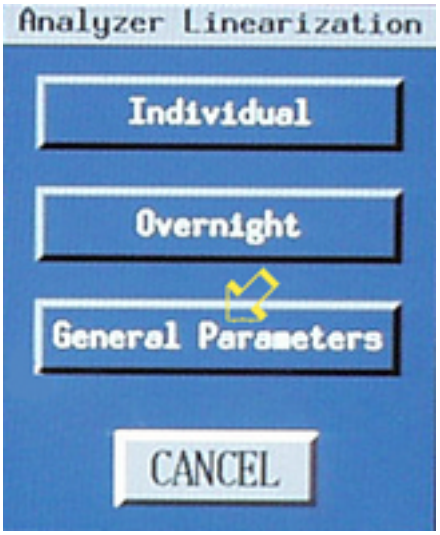


Figure 5
Analyzer Linearization Panel

113 On the “General Parameter Setup” panel, click on the “Gas Divider Setup” button. See the arrow in Figure 6.


Figure 6
General Parameter Setup Panel

114 On the “Standard Gas Divider Setup” panel, verify that the field adjacent to the “Divider Type” button is set to “GDC 700.” If not, click on “Divider Type.” See the arrow in Figure 7. Select “GDC 700” from the menu. See the circle in Figure 7.

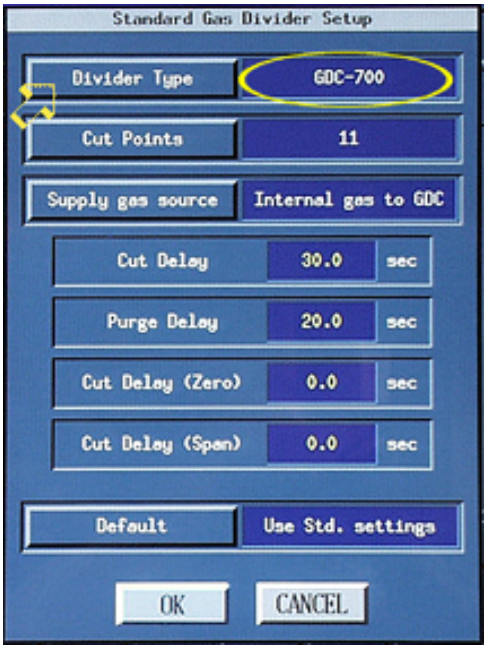


Figure 7
Standard Gas Divider Setup Panel

115 Click on the “Cut Points” button. See the arrow in Figure 8.

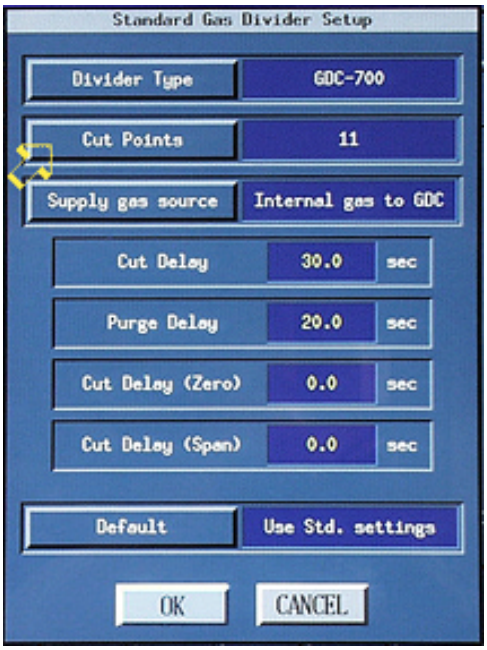


Figure 8
Standard Gas Divider Setup Panel for “Cut Points”

116 On the "Cut Point Set" panel, verify that the default set is selected. The default set is; Cut #1 = 0, Cut #2 = 10.0, Cut #3 =20.0 and increasing by 10 percent each cut to Cut #11 = 100.0. See the circle in Figure 9.

If the default set is not selected, click on the "Default Set" button. See the arrow in Figure 9. At the bottom of the "Cut Point Set" panel, click on "OK."

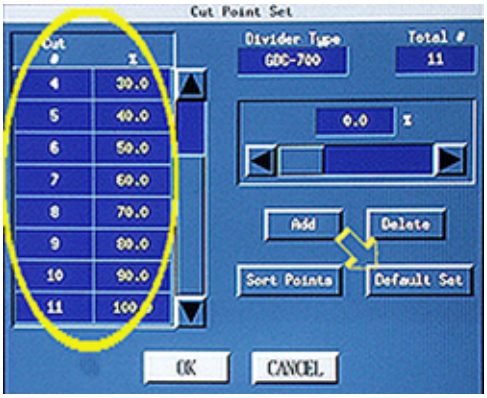


Figure 9
Cut Points Set Panel

117 On the “Standard Gas Divider Setup” panel, verify that the field adjacent to the “Supply gas source” button is set to “External gas to GDC.” If not, click on“ Supply gas source.” See the arrow in Figure 10. Select “External gas” from the menu. See the circle in Figure 10.

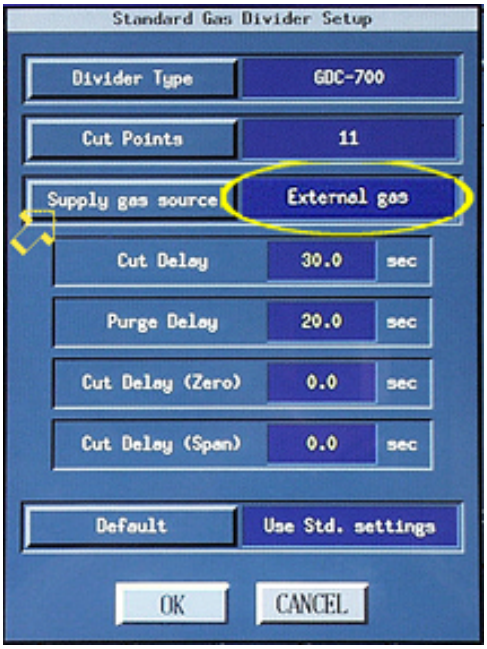


Figure 10
Standard Gas Divider Setup Panel for External Gas

118 Verify that the field for “Cut Delay” displays “60.0.” for NOx and CH4, “30.0” for all other gases. If it doesn’t, click in the field and use the on-screen keypad to enter the correct data. See the circle in Figure 11. On the key pad, click on “OK.”


Figure 11
Standard Gas Divider Setup Panel for Cut Delay

119 Verify that the field for “Purge Delay” displays “30.0.” for NOx and CH4, “20.0” for all other gases. If it doesn’t, click in the field and use the on-screen keypad to enter the correct data. See the circle Figure 12. On the key pad, click on “OK.”


Figure 12
Standard Gas Divider Setup Panel for Purge Delay

120 Verify that the field for "Cut Delay (Zero)" displays "0.0." If it doesn't, click in the field and use the on-screen keypad to enter the correct data.
See the circle in Figure 13. On the key pad, click on "OK."


Figure 13
Standard Gas Divider Setup Panel for Cut Delay (Zero)

121 Verify that the yellow user changeable field for "Cut Delay (Span)" displays "0.0." If it doesn't, click in the field and use the on-screen keypad to enter the correct data.
See the circle in Figure 14. On the key pad, click on "OK."


Figure 14
Standard Gas Divider Setup Panel for Cut Delay (Span)

122 Verify that the field for “Default” is set for “Use Std. settings.” If not, click on “Default.” See the arrow in Figure 15. Select “Use Std. settings.” See the circle in Figure 15.

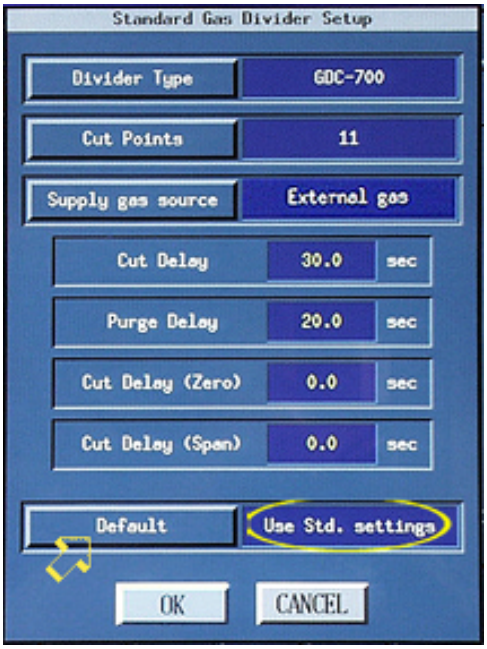


Figure 15
Standard Gas Divider Setup Panel for “Use Std settings”

123 Click on “OK.” See the arrow in Figure 16. The “General Parameter Setup” panel will appear.

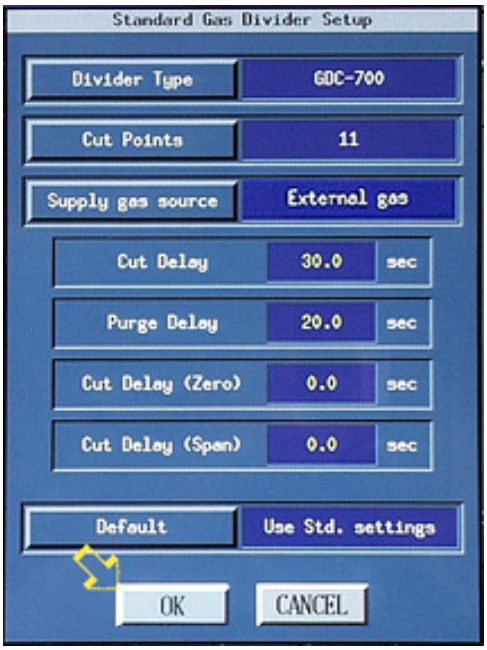


Figure 16
Standard Gas Divider Setup Panel Completion

124 On the “General Parameter Setup” panel, click on the “Standard Curve Settings” button. See the circle in Figure 17.


Figure 17
Select Standard Curve Settings

125 On the “Standard Curve Settings” panel, Verify that the field for “Curve Order” displays “Auto.” If not, click on “Curve Order.” See the arrow in Figure 18. Select “Auto.” See the circle in Figure 18.


Figure 18
Select Auto

126 Verify “Weights” in the field for “Fit Criteria.” If not, click on “Fit Criteria.” See the arrow in Figure 19. Select “Weights.” See the circle in Figure 19.


Figure 19
Standard Curve Settings for Weights

127 Under “Error Criteria,” verify that all fields contain “EPA.” If not, click on the appropriate button. See the arrows in Figure 20. Select “EPA.” See the circle in Figure 20.

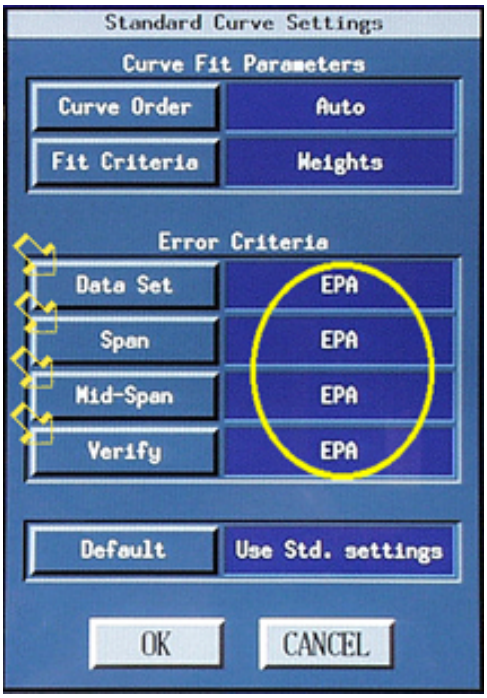


Figure 20
Standard Curve Settings to Verify "EPA"

128 Verify that the field for “Default” displays “on “Use Std. settings.” If not, click on “Default.” See the arrow in Figure 21. Select “on “Use Std. settings.” See the circle in Figure 21.


Figure 21
Standard Curve Settings to set “Use Std settings”

129 Click on “OK.” See the arrow in Figure 22. The “General Parameter Setup” panel will appear.


Figure 22
Standard Curve Settings Completion

130 On the “General Parameter Setup” panel, click on the “Error Criteria Sets” button. See the arrow in Figure 23.

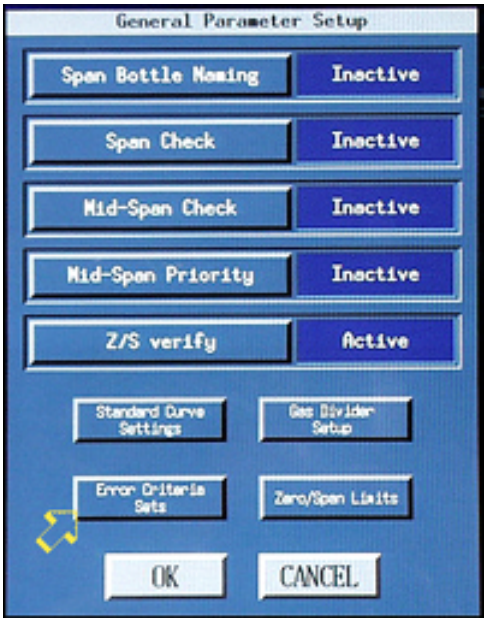


Figure 23
General Parameter Setup Panel

131 In the scrolling region of the “Error Criteria Sets” panel, ensure that “EPA” is selected. See the circle in Figure 24. Click on “OK.” See the arrow in Figure 24. The “General Parameters Setup” panel will appear.

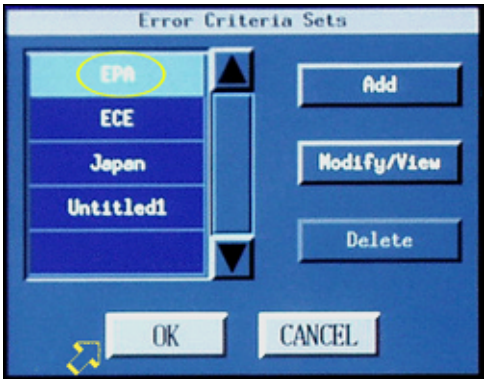


Figure 24
Error Criteria Sets Panel

132 On the “General Parameters Setup” panel, Verify that the field adjacent to the following buttons are set as follows.

| Button | Setting |
|---|---|
| “Span Bottle Naming: | “Inactive” |
| “Span Check” | “Inactive” |
| “Mid-span Check” | “Inactive” |
| "Mid-Span Priority" | "Inactive" |
| "Z/S Verify” | “Active” |

If not, click on the appropriate button and select the proper setting. Click on "OK." See the arrow in Figure 25.

The “Analyzer Linearization” panel will appear.


Figure 25
General Parameters Setup Completion

133 On the “Analyzer Linearization” panel, click on the “Individual” button. See the arrow in Figure 26.

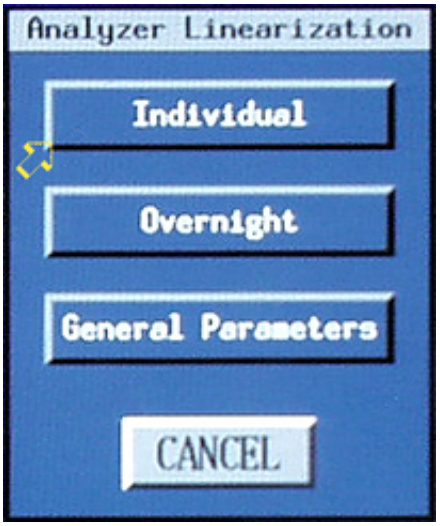


Figure 26
Analyzer Linearization Panel

134 On the “Analyzer Linearization,” sub-panel, verify that the field adjacent to the following buttons are set as follows. See Figure 27.

| Button | Setting |
|---|---|
| “Line” | The bench under test |
| “Component” | The analyzer under test |
| “Range” | The operating range |

If not, click on the appropriate button and select the proper setting. Click on the “Parameter Setup” button. See the arrow in Figure 27.

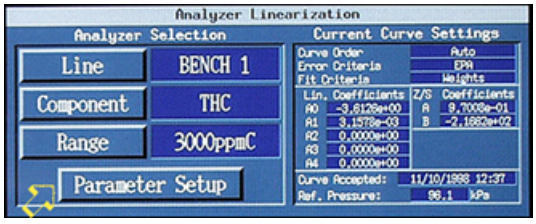


Figure 27
Analyzer Linearization to Verify Data

135 On the "Parameter Setup" sub-panel, click on "Gas Source & Concentrations." See the arrow in Figure 28.

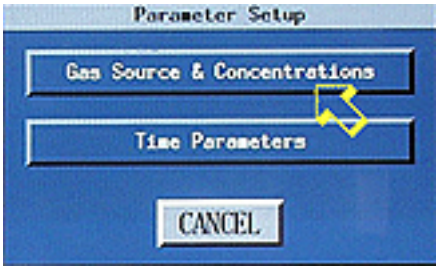


Figure 28
Parameter Setup Sub-Panel

136 Verify that the field for “Verify Manual Gas Source” displays “External gas.” If not, click on “Verify Manual Gas Source.” (see the arrow in Figure 29) and then select “External gas.” See the circle in Figure 29.


Figure 29
Parameter Setup to Verify “External gas”

137 Verify that the field for “Top Gas Source” displays “Bottle Label.” See the circle in Figure 30. If not, click on “Top Gas Source.” See the arrow in Figure 30.

Select “Bottle Label.”

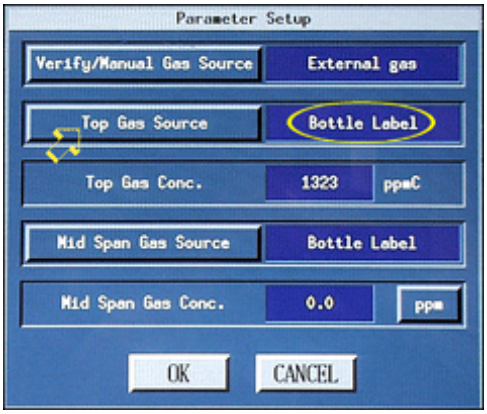


Figure 30
Parameter Setup to Verify "Top Gas Source"

138 For “Top Gas Conc.” click in the adjacent field and use the on-screen keypad. See the circle in Figure 31.

Enter the gas concentration value from the label of the secondary bottle noted in Step 105. On the key pad, click on “OK.”

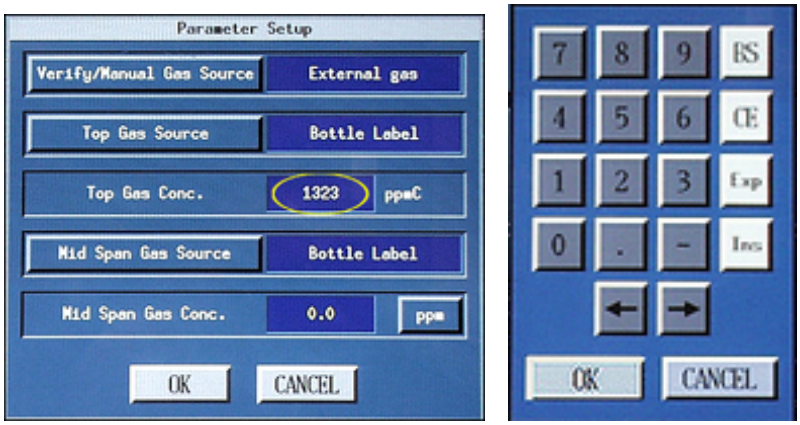


Figure 31
Parameter Setup to set “Top Gas Conc.”

139 Verify that the field for “Mid Span Gas Source” displays “Bottle Label.” See the circle in Figure 32. If not, click on “Mid Span Gas Source.” See the arrow in Figure 32. Select “Bottle Label.”


Figure 32
Parameter Setup to Verify "Mid Span Gas Source"

140 For “Mid-span Gas Conc.” click in the adjacent field and use the on-screen keypad to enter the gas concentration value from the label of the mid-span bottle noted in Step 106. See circle in Figure 33. On the key pad, click on “OK.”

On the “Parameter Setup” panel, click on “OK.” See the arrow in Figure 33.

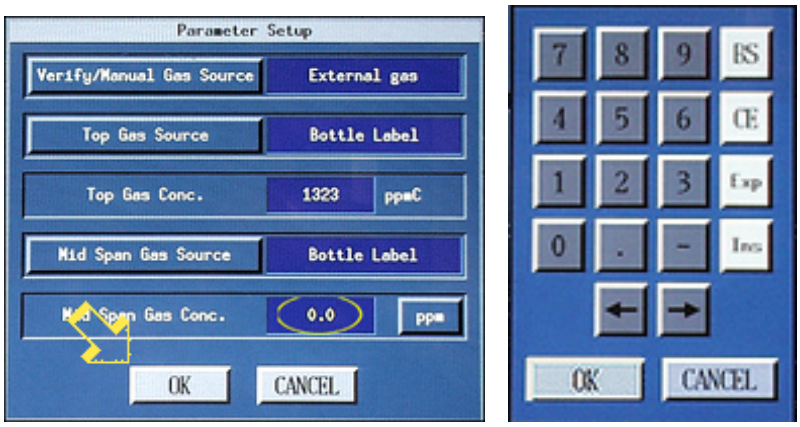


Figure 33
Parameter Setup to Set "Mid Span Gas Conc."

141 On the smaller “Parameter Setup” sub-panel, click on “Time Parameters.” See the arrow in Figure 34.

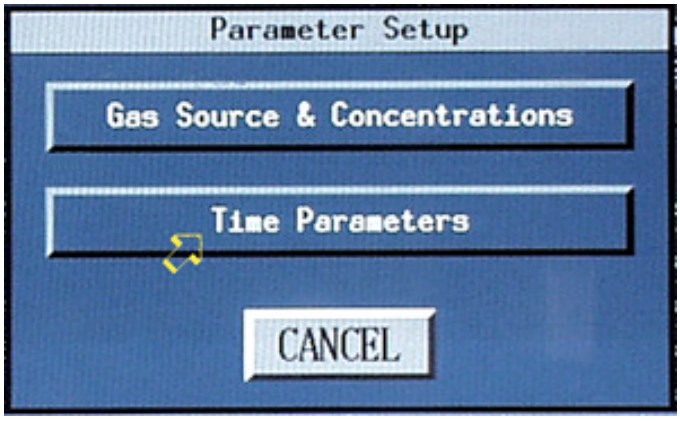


Figure 34
Parameter Setup Sub-Panel to Select "Time Parameters"

142 For “T1” click in the adjacent field. See the circle in Figure 35. Use the on-screen keypad to enter 30 then click on “OK.” See the arrow in Figure 35.

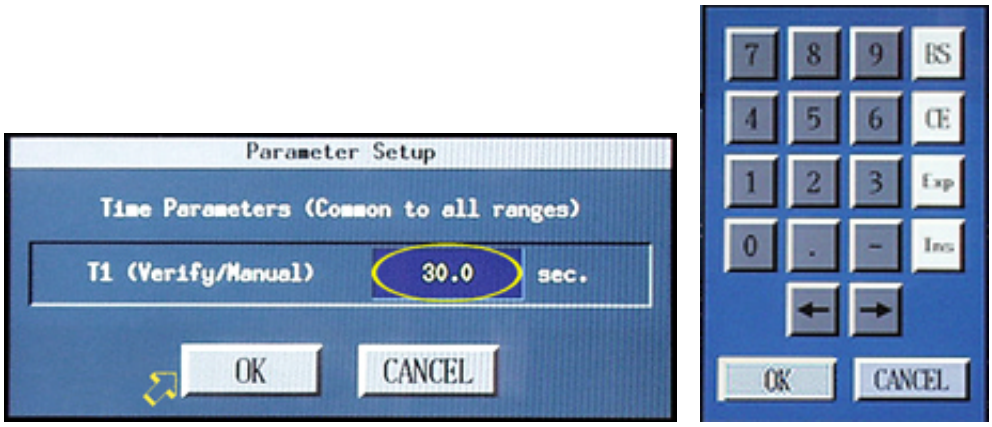


Figure 35
Parameter Setup Sub-Panel to Enter “T1” Value

143 On the next “Parameter Setup” sub-panel, click on “CANCEL.”

144 Connect the secondary bottle to the “Bottle” quick-disconnect connector on the SVS panel of the bench under test.

Ensure the regulator pressure is set to 13 - 15 psi.

145 On the “Analyzer Linearization” sub-panel, click on the “Collect Candidate Data Set: button. See the arrow in Figure 36.

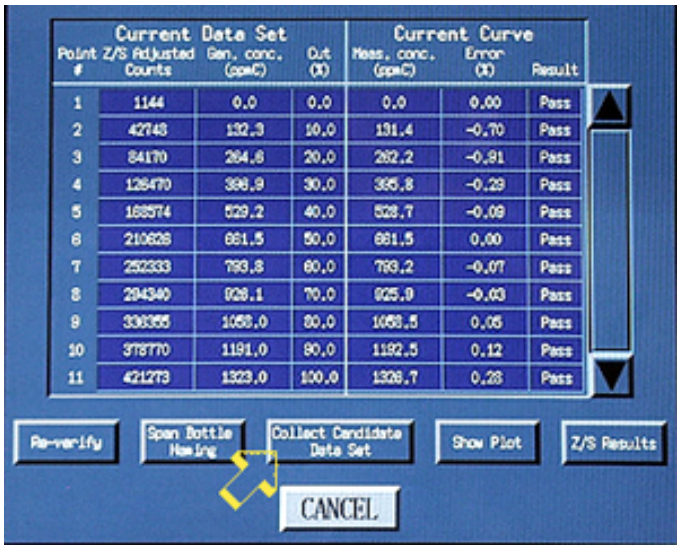


Figure 36
Analyzer Linearization Sub-Panel

146 On the "Linearization Data Collection Panel," click on the "Collect Data with Gas Divider" Button. See the arrow in Figure 37.

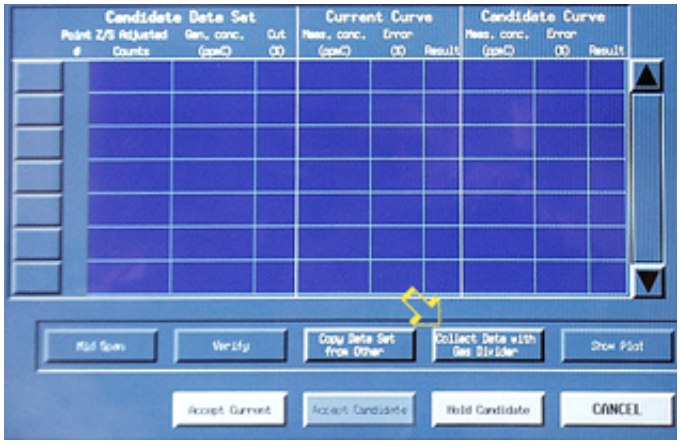


Figure 37
Linearization Data Collection Panel

147 On the “Gas Divider Setup” panel, verify that the field for “Top Gas” matches the value in Step 138.

If not, use the on-screen alpha-numeric keyboard to enter the correct data. See the circle in Figure 38. On the key pad, click on “OK.”


Figure 38
Gas Divider Setup Panel

148 Verify the following settings:

| Button | Setting |
|---|---|
| “Divider Type” | “GDC 700” |
| “Cut Points” | “11” |
| “Supply Gas Source” | “External gas” |

Change an incorrect setting by clicking on the button. See arrows in Figure 39. Select the correct data. See the circles in Figure 39.

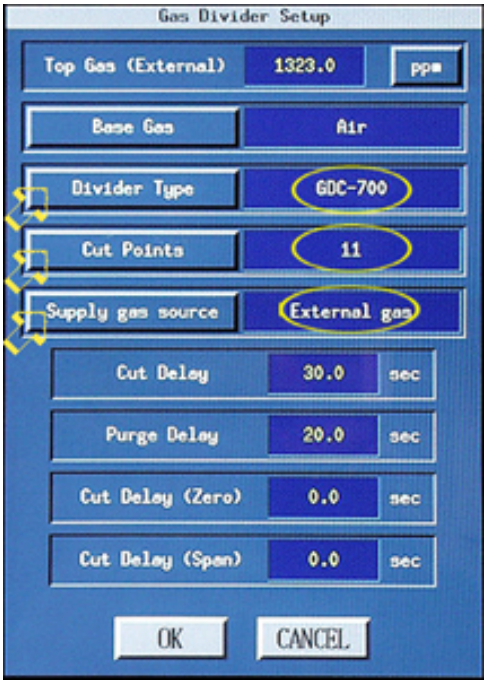


Figure 39
Gas Divider Setup to Verify "Gas Divider Setup"

149 Verify the “Setting” data corresponds for each of the following “Fields”:

| Field | Setting |
|---|---|
| “Cut Delay” | 60.0 for NOx, 30.0 for all other gases. |
| “Purge Delay” | 30.0 for NOx, 20.0 for all other gases |
| “Cut Delay (Zero)” | 0.0 |
| “Cut Delay (Span)" | 0.0 |

150 Change any incorrect setting by clicking in the appropriate field. See the circles in Figure 40. Using the on-screen alpha-numeric keyboard to enter the correct data. When all entries are correct, click “OK.” See the arrow in Figure 40.


Figure 40
Gas Divider Setup to Verify "Gas Divider Setup" Fields

151 The “Analyzer Calibration” panel will appear. When completed, “Calibration successfully completed” will appear. Click on “OK.” See the arrow in Figure 41. The "Interference Check Result Reset" panel will appear.

If “Calibration Failed” appears, the process was not successful. Click on “Restart Cal.” and if the calibration fails a second time, notify the senior technician.


Figure 41
Analyzer Calibration Panel

152 The test will automatically begin and the progress panel will appear which will automatically update as the test proceeds.

After each point is run, the gas divider will purge and reset. A check will appear in the far left column as each point is completed. See the circle in Figure 42.

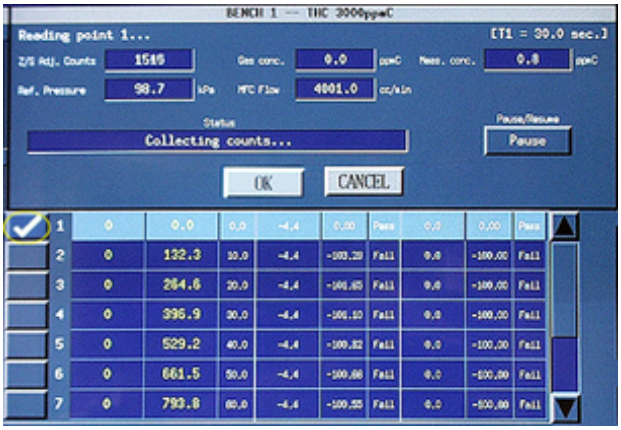


Figure 42
Progress Panel

153 When all points have run, scroll through the 11 points and verify that the far right column for each displays “Pass” indicating less than 1% of point from the curve.

If any point displays “Fail,” go to Step 145 and repeat the procedure a second time.

If any point displays “Fail” after the second try, notify the senior PNGV technician before proceeding.

154 When all 11 points display “Pass.” See the circles in Figure 43. Click on “Accept Data Candidate.” See the arrow in Figure 43.

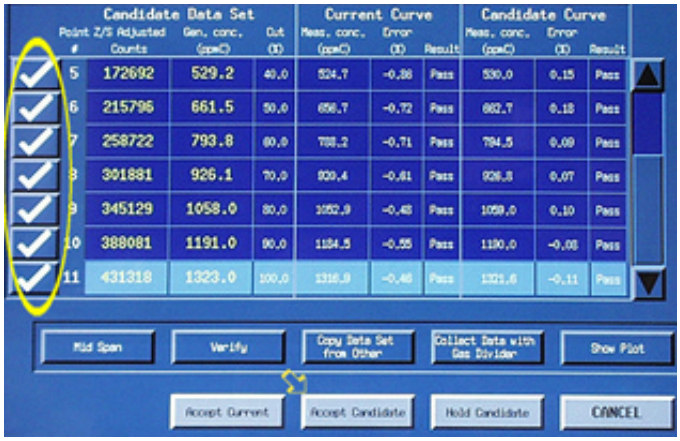


Figure 43
Verify Pass / Fail

155 When the Gas Divider Sequence dialog box appears with the message “Are you sure you want to accept the candidate curve? “, click “OK.”

See arrow in Figure 44.

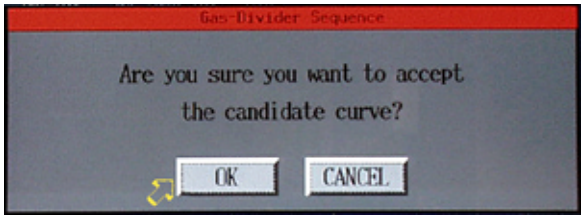


Figure 44
Gas Divider Sequence Dialog Box

156 Connect the mid-span bottle to the “Bottle” quick-disconnect connector on the SVS panel of the bench under test. Ensure the bottle pressure is set to 13 - 15 psi.

157 On the "Linearization Data Collection" panel, click on the “Mid Span” button. See the arrow in Figure 45.

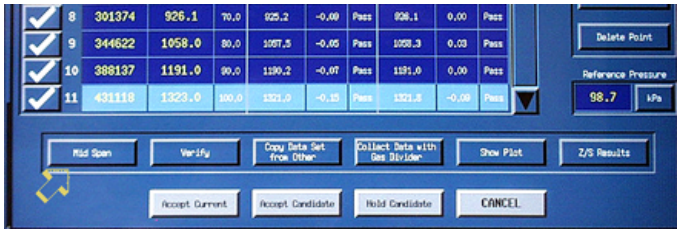


Figure 45
Linearization Data Collection Panel for “Mid Span”

158 On the “Analyzer-Mid Span Check” panel, click in the “Mid Span Gas Conc.” field. See the circle in Figure 46 Use the on-screen keypad to enter the gas concentration value from the bottle in Step 140. On the keypad, click “OK.”

On the Analyzer Mid-Span Check panel, Click on the "Read Counts" button. See the arrow in Figure 46.

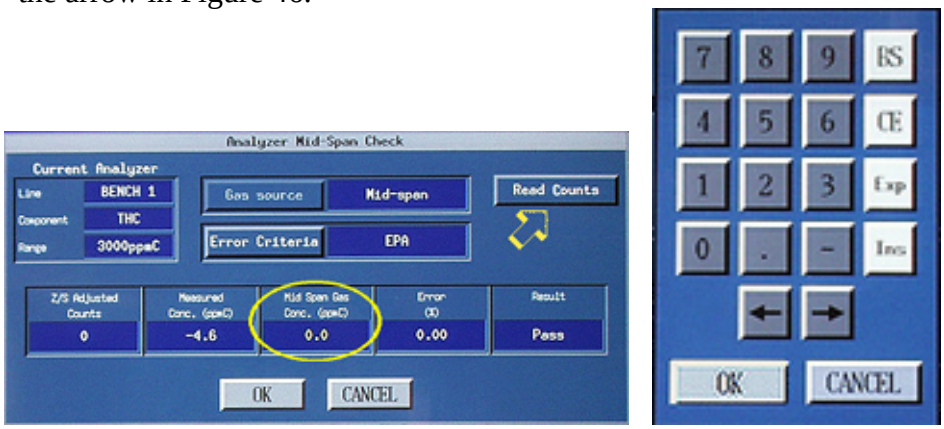


Figure 46
Analyzer Mid-Span Check Panel

159 A sub-panel labeled with the bench number, analyzer in use, and range under test will appear. When the automatic mid-span check is complete the “Analyzer Mid Span Check” will appear and “Pass” should display under “Result.” See the circle in Figure 47. If “Fail” appears, Click on the “Read Counts” button again.

If “Fail” appears a second time, notify the senior PNGV technician before proceeding. When “Pass” appears, click on the Horiba logo button on the title bar. See the arrow in Figure 47.


Figure 47
Analyzer Mid Span Check Panel to Verify “Pass / Fail”

160 Click on “Hardcopy.” See the circle in Figure 48.

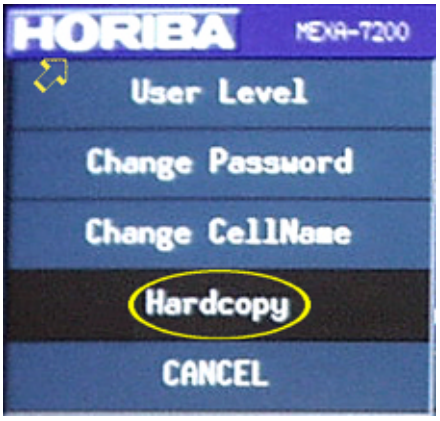


Figure 48
Horiba Title Bar

161 Click on “Sub-panel.” See the circle in Figure 49. Click inside the sub-panel. A hardcopy of the sub-panel will print on the control room printer. Retain for attachment to the Analyzer Linearization Data sheet.

On the “Analyzer Mid Span Check” panel, click on “OK.”
See the arrow in Figure 49.


Figure 49
Analyzer Mid Span Check Sub-Panel

162 When the “Analyzer Linearization,” sub-panel appears, click on the Horiba logo button on the title bar. See the arrow in Figure 50.

Click on “Hardcopy." See the circle in Figure 50.

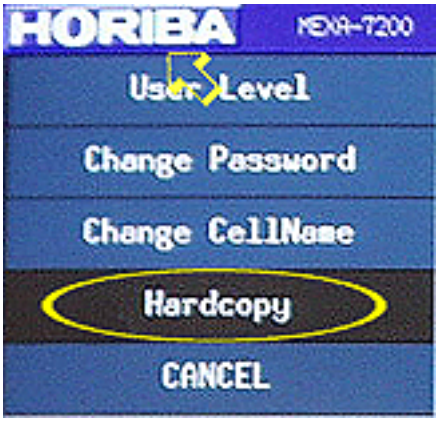


Figure 50
Horiba Title Bar

163 Click on "Sub-panel." See the circle in Figure 51. Click inside the "Analyzer Linearization" sub-panel. A hardcopy of the sub-panel will print on the control room printer. Staple the hardcopy with the printout from Step 161 and file them in the diagnostics file folder.

Click on “Cancel.” See the arrow in Figure 51.


Figure 51
Analyzer Linearization Sub-Panel

164 On the “Analyzer Linearization,” sub-panel, click on “Cancel.” See the arrow in Figure 52.

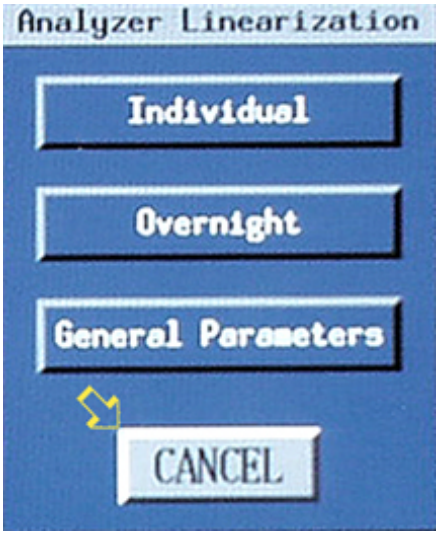


Figure 52
Analyzer Linearization Panel

165 On the “Supervisor” screen, click on the “Menu” button. See the arrow in Figure 53. Select “Command” from the menu. See the circle in Figure 53.


Figure 53
Menu Panel

166 On the title bar, click on the Horiba logo button See the arrow in Figure 54. Select "User Level" from the menu. See the circle in Figure 54.

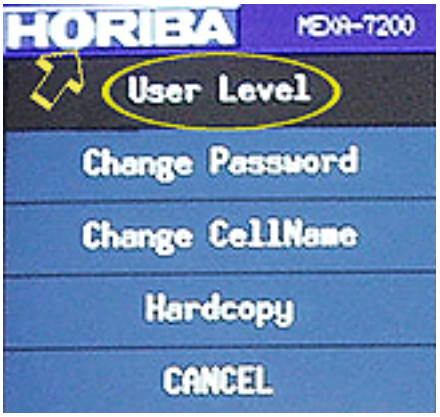


Figure 54
Horiba Title Bar

167 Disconnect the secondary bottle from the "Bottle" quick-disconnect connector on the SVS panel of the bench and re-connect all lines from the SVS to the gas divider panel.

168 Return the secondary bottles to the storage area.

## 3. Acceptance Criteria

3.1 The secondary bottle concentration range should be between 20% - 80% of the range for the curve verification and the regulator pressure is set to 13 - 15 psi.

3. 2 The 11 data points in the far right column of the “Progress” panel must display “Pass.”

3.3 The mid-span check must indicate “Pass” in the display area under “Result” on the “Analyzer Mid Span Check” panel.

3.4 On the “Are you sure you want to accept the candidate curve?” dialog box, the far right column for “Mid” must display “Pass.”